EXHIBIT 15

CONVERSATION WITH RICHARD TAYLOR

QUANTEL'S CREATIVE VISION

Managing director Richard Taylor recalls Quantel's role in the history of digital picture processing, and how a quest for technological transparency has led to worldwide visibility—and success.

Paintbox, Harry, Mirage, Encore...one would be hard-pressed to find a video professional in the free world unfamiliar with at least one of these product names—if not all of them—or with the name of the company responsible for bringing this equipment to the marketplace: Quantel. Based in Newbury, England (30 miles west of London), Quantel was founded in 1973 as a sister company to Micro Consultants Ltd., a British firm involved in the then-new field of digital picture technology. Fifteen years and numerous innovative products later, Quantel has grown into an international leader in the field of electronic graphics, digital video effects, picture storage, and television standards conversion. The company is also involved in nuclear, X-ray, radar, and other forms of advanced picture processing, but Quantel is most famous for its pioneering work in video technology.

Richard Taylor, Quantel's managing director, has been with the company from the beginning, and has led the team of engineers who exploited the advanced technology behind Quantel's success. An electrical engineer, Taylor recently took time out from one of his frequent trips to the U.S. to sit down with editorial director and publisher John Rice and editor Brian McKernan, to review the history of Quantel and the strategy behind its world-reknown video equipment.

VIDEOGRAPHY: *You joined EMI [Electronic Music Industries] in the late Sixties after earning your masters degree at London University. How did your work at EMI lead you toward creating Quantel?*

TAYLOR: I started my career in the pattern-recognition department of EMI. One of the problems the company was trying to solve at that time was how to register automatically a color camera. EMI built the first four-tube color camera in the U.K.; they were interested in moving to a three-tube color camera, and there were problems in registering it. So that kindled my interest in the broadcast side of the business. But then I moved around EMI, getting experience in large systems and management. I began to work on infrared image processing equipment to build one of the world's first standards convertors—not for broadcast television, but to take a weird rotating prism-scanned infrared system and turn it into a television output. It was a classified project, but basically it was to be able to see people and objects in total darkness.

In order to do that, I needed A-to-D [analog-to-digital] and D-to-A convertors. I bought those from the only people that were making them in the U.K., a company called Micro Consultants. This was in 1972. They were interested in further developing their projects, a conversation started, and it led to me joining Micro Consultants to make a device called Intellect, which was something I'd wanted to build for a long time.

VIDEOGRAPHY: *What was Intellect?*

TAYLOR: It was a machine that could take a television picture or a thermal camera picture into a store, and display it on a screen while a computer was allowed random access to the store. And that meant you could take the picture in, analyze it, modify it in the computer, or generate totally synthetic images in the computer, put them into the store, and look at them. That sounds very mundane today, but in 1973 that was really quite unique.

VIDEOGRAPHY: *And the application for that product?*

TAYLOR: Intellect allowed image-processing researchers to work with almost any picture. The product proved enormously successful, and was only phased out of production about two years ago.

Something else interesting happened, because in order to be able to do this, the machine was designed so the input was asynchronous to the output. And almost without knowing, what we actually designed was a television synchronizer. It was monochrome, but nevertheless it was a synchronizer. The very first customer for this machine wanted a device that could fly; so we made Intellect very, very small. We found we had a monochrome synchronizer that was just eight inches tall. Then we set out to turn it into a full-NTSC color synchronizer, in 1974. That really is when Quantel as it is known

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today was formed; Quantel stands for quantized television.

The device became known as the 3000 Synchronizer. We brought it to the fall SMPTE, in Detroit, and thought we had something that was quite interesting. In fact, we were inundated with crowds that came to see this device. If you remember, the main synchronizer at that time was the NEC system, which was seven feet tall. So we were contrasting 84 inches with 8 inches. That led us to think we need our own company in America if we're going to sell there successfully and support our customers. So we formed our own company in Palo Alto CA.

VIDEOGRAPHY: *That company was a sales and support service, correct?*

TAYLOR: Yes. We were helped by the networks in developing the synchronizer because, frankly, there were great gaps in our knowledge about what was needed to make a piece of broadcast equipment acceptable for the U.S. market. Julie Barnathan, of ABC, bought 10 machines at the Chicago NAB the following year, for the network's sports trucks. By that time, we'd put a compressor into the machine to compress the picture to quarter-size.

"We tried to design the machines in a way that didn't impose any style on the user."

VIDEOGRAPHY: *For inserting pictures-within-pictures?*

TAYLOR: Yes, the reaction of one player's face while some other activity was happening. Again, things that are common now, whereas then it was all very special stuff. Julie put great faith in us. We always admired him for his courage, really. We told him we were going to have a compressor, but at the NAB show somehow we hadn't quite sorted out and finished its development. So yes, we could compress the picture, but the color went into one part of the screen and the luminance went into another part of the screen. I told Julie we'd solve that problem. Fortunately he believed me, and fortunately we did.

VIDEOGRAPHY: *Where did Quantel go from there?*

TAYLOR: To the 1976 Montreal Olympics. We had a contract with the CBC, also for picture compressors attached to synchronizers. It was while we were in Montreal that we began to fully realize that the use of the synchronizer was not an engineering function. We had almost inadvertently backed into the creative part of the industry, because the business of using a compressor can become a creative decision. We began to discover the insatiable demands of creative people. They said to us, "Fine, you've made it shrink a picture to quarter-size. Now why can't you make it zoom smoothly?"

We sort of laughed and said, "No, that's incredibly difficult. You've got to be joking." We actually disappeared for a year, and developed what became known as the 5000. That really, I think, is what launched Quantel into the real-world market. It is not an exaggeration to say there was hardly a broadcaster around the world that didn't have aspirations to own one of these devices. We were desperately trying to manufacture them fast enough, and were happy to cope with that while we were expanding and building new factory space.

We learned early on that just being able to do something to the picture is only half the story. The other half is: How do you manage to get somebody to be able to use it with all the other pressures there are in a live broadcast or an edit suite? We also learned that people become bored very quickly with the same thing. So we tried to design the machines in a way that didn't impose any style on the user. It was entirely up to the user what the machine did and what appeared on the screen. At that time we were competing with Vital, and we each chose a different approach. They chose the approach of an effect under each button. We chose an approach with a control panel where you can create any effect you wanted. Fortunately history has proven that our more flexible approach was the right one, although it took a little while for people to get used to it and begin to accept it.

VIDEOGRAPHY: *We're talking about the control design for which product?*

TAYLOR: For the Model 5000 effects machine. But really, that philosophy has gone into all of our products.

VIDEOGRAPHY: *What came next after the 5000?*

TAYLOR: The still store. At that time there were two other companies involved in still stores: Ampex, using the system they developed with CBS; the other was Adam. But we felt the architecture and control mechanisms of both those machines were limiting. And that's why we developed the three-store concept, where you could have three frame stores. You have your information stored on disc, and you have three frame stores, one of which is used entirely for editorial work, and then two that are used on-air, where you had your current and your next slide. You could dissolve with them; you could do effects that were built into the machine. Again, that was very revolutionary. When we first brought it out, everyone said, "What the hell do you want three stores for?" Quantel's competing with machines that only had the cost of one store in them required the company to get its message across. Today, I believe, it's the world's largest-selling still store—the DLS [digital library system] 6000 Series still stores.

VIDEOGRAPHY: *When does the Paintbox make its entry into the history of Quantel?*

TAYLOR: We have to go back to the very early Intellect, back in the early Seventies, because one of our engineers had written a program that could paint to entertain his children. You could pick up a stylus, move it around on a tablet, and you could draw little figures. We took it to the IBC exhibition,

at Grovesnor House, and showed it in a private suite. Visitors said "No, that's no good, you'll never get an artist to use a computer." And we felt they were right, but we didn't shelve the idea; we simply thought, "Fine, we'll bide our time."

We sat down to work it out, and the criteria we set ourselves was that this device shouldn't look like a computer in terms of its output, and it shouldn't look like a computer to the artist. That took a long time, but gradually the ideas came to us, and we went through the process to design a machine that could draw beautifully. We gave the machine to a well-known graphics designer to try out, and she couldn't do anything with it at all. We were very puzzled by this. It was actually quite depressing, and we thought, "Oh dear, what do we do now?"

There was an artist we knew, named Martin Holbrook, who had his own business. We invited him to come in and play with the machine. He agreed, and came one evening, very intimidated by a room of humming machinery—because at this stage the machine was spread all over the workbench. He was shown how to operate the device, and then some distraction happened, and he was left alone with it. Lo and behold, when we returned there was a beautiful landscape he'd drawn, at which point he was busy scrubbing it out because he wasn't happy with his drawing. He adored the machine, and became totally hooked on it.

We brought him to the NAB, in Las Vegas, to demonstrate it. We had a private suite in the Hilton, with a camera looking out across the skyline of the city. Martin was busy changing the skyline of Las Vegas. It was a magical time. Nevertheless, we were very concerned that the graphics designer we originally invited in hadn't been able to use the machine.

VIDEOGRAPHY: *Did you identify that problem?*

TAYLOR: It became clear to us during that exhibition that there were two different types of people: illustrators and graphic designers. You get some people who are both, but they're not the same thing at all. That first person was a graphic designer, and she actually couldn't draw. A wonderful composer of pictures, but not someone who could do freehand drawing. What we developed was a freehand drawing machine.

Now we had a strange situation where people were trying to press money into our hands to buy the Paintbox, as it became known, and we had to make a difficult decision and say "No, we won't sell it to you because we're not happy with it." And in fact we disappeared and came back with what is now the Paintbox today, which has all the graphic design functions in it. I'm very pleased to say that that lady is now a proud owner of one.

VIDEOGRAPHY: *Does the Paintbox relate back to something you talked about before: the realization of the company's new direction in its product lines, from the technical to the creative?*

TAYLOR: Yes, that's another manifestation of how we ceased to become engineers selling to engineers. We went through a transition of becoming engineers selling to creative people. Now we have a fairly large staff of creative people who help in selling to creative people, and help to develop new ideas for machines for creative people.

Incidentally, you mentioned Paintbox as a finished product, and I just have to pick up on that. One of the other things that we learned very quickly is that, in our business, it's very bad news to come to NAB and say, "Never mind the products you bought last year, we've got a great one this year, so last year's is obsolete." You very quickly lose friends that way. We decided early on to try and make all our machines with hooks in them so that you could develop, grow, and build on them. If you look at both the Library Systems and the Paintbox, from what they were when they first appeared to the models we sell today, they are very different machines. Yet, the very first Paintbox ever delivered is actually already upgraded with the very latest set of features.

VIDEOGRAPHY: *Let's talk about Harry, or is there something in between?*

TAYLOR: The machine that came in between was Mirage. That was something where we tried to provide the ultimate flexibility for the creative person. The story I've tried to tell is a whole series of developments designed to enhance the creative person's freedom. That's really where Harry comes into the story. If you look to what was happening with Paintbox, we took graphic designers and enabled them to move from the wings to center stage. Nowadays, if you're booking a show, you won't only book your talent and your director; you'll also book your graphic designer. Seven or eight years ago that most definitely was not the case. I don't think it's too boastful to say that that was entirely because of the Paintbox. It has revolutionized the look of television, and the life of graphics designers. The same applies, we feel, to the editing and compositing area of the business. Often the creative person is blocked because there's a huge wall of technology in his or her way.

With Harry, what we set out to do was to put the creative person directly in control of the destiny of the piece they're working on. That's why it's a tablet-controlled mechanism; it follows Paintbox simply because Paintbox proved to be so incredibly effective. We then took the control mechanism on, so that it now controls all the editing functions and the keying functions, and systems like Rainbow that allow you to change the color characteristics through the gammas.

The latest introductions at NAB allow you to actually shuttle and jog tape recorders directly from the tablet. Why should a creative person have to go up to a tape recorder and push buttons and turn knobs? When he wants to shuttle or spool with our E-Motion system, he puts the pen on the tablet, and if he wants to shuttle to the left he moves the pen to the left, and if he wants to jog he just moves it around in whichever direction he wants to jog. It's a wonderfully natural way of doing things. That, I guess, is what our policy and philosophy is. You hide the technology totally, and allow a creative person, who has no interest at all in that technology, to use it to do whatever he or she wants to do creatively.

"Paintbox is not a generic name; Paintbox is a trademark of Quantel."

VIDEOGRAPHY: *We have to ask you the question that's brewing up with all of the keyboard-based, technology-based editors: We want to know why you never hung a keyboard off of the Harry tablet?*

TAYLOR: I guess the answer is: Why would you want to do that?

VIDEOGRAPHY: *Because the people who are the technology-*

driven editors, the people who do shuttle the tape machines, the people who do enter the frame numbers, people who learned on systems such as the CMX—who didn't come to editing after being graphic artists and illustrators—are comfortable with the keyboard. Now, quite honestly, they are forced into working on a Harry, and now they're at a loss.

TAYLOR: No they're not. To be able to sit in a edit room and discuss with a client the edit decisions, the editor does have a lot of creative skills. What we've seen is that editors are only too pleased to get away from having to type in all sorts of codes and thunder away on a computer keyboard to do something. We are giving editors freedom. After all, a film editor is someone who doesn't have to worry about the technology. Our feeling is that if we were to put a keyboard on, it would be a retrograde setup.

VIDEOGRAPHY: *Possibly the most important question of the day: How did Harry get his name?*

TAYLOR: Do you know the story about Big Ben, the clock that's on the top of the House of Parliament in London? There was a bell cast for this special clock in the tower, and one of the committees of Parliament was trying to decide what name to call it. There were all sorts of suggestions, and none seemed to fit. In the end, someone was getting tired and wanted to go off for dinner and he said, "Oh, to hell with it, why don't you just call it Big Ben?"

All our machines in the lab have nicknames, usually a person's name. The machine we're talking about had the name Harry. We tried to think of a trade name for it and we couldn't, because everything we tried to use as a descriptor was limiting—the machine does so much. If you talk about it as being a keyer, it's much more than that. An editor, it's much more than that. A random-access disc recorder, it's much more than that. In the end, there was one meeting where we just said, "Oh, the hell with it, why don't we just leave it and call it Harry?" The story's not quite true, because the original name was Henry. I suspect you might have seen the prototype Henry in one of the NAB exhibit suites years ago. It got changed from Henry to Harry at the time that Prince Harry was born to Charles and Diana.

VIDEOGRAPHY: *Wasn't there was one trade show, an NAB, where you had a Harry and a Henry?*

TAYLOR: Yes, there was a transition period as we were still exploring exactly what form we wanted this to be.

VIDEOGRAPHY: *Speaking of names, the use of the word* Paintbox *is often applied to any manufacturer's electronic art/paint system, and of course Paintbox is the proper product name of Quantel's machine. Is that generic use a problem for the company, in the same way that people say* Xerox *to refer to any brand of photocopy machine?*

TAYLOR: I am afraid that I have to stringently insist that Paintbox is not a generic name; Paintbox is a trademark of Quantel. Anybody that attempts to use it to describe their equipment gets a letter from our lawyers.

VIDEOGRAPHY: *The direction we're trying to go in is that, from our point of view, it's a credit to the product, that it has become a phrase used to describe all of these products.*

TAYLOR: The machine has set the standard that others try to follow, I guess. It's an incredibly precious thing. We've had several situations where designers have moved to facilities simply because they wanted to work on a Paintbox.

VIDEOGRAPHY: *The Paintbox has inspired many competitors to move into that arena. Do you suspect that Harry will eventually be joined by Harry clones?*

TAYLOR: Yes, I think it must, because I am sure it is the way to go. We move from film editing to technological editing. Film editing is editing with pictures; computer-based editing is editing with numbers. What we're doing now is going back to editing with pictures. You wouldn't want to edit a soap opera using a Harry. That's not what it's for. And you wouldn't want to switch live on-air on a sports program using a Harry. But for the type of editing that you associate with film-type editing, it is exactly what the machine is designed for. Yes, I'm sure it will spawn other people working on that technique.

VIDEOGRAPHY: *At this NAB, we saw the introduction of*

HarrySound. Why? What's the concept behind it?

TAYLOR: Exactly the same argument, again: that the creative designer wants to be able to work with sound. We'd introduced this scratch-track audio system so that a creative designer could edit video to a scratch track audio system within Harry. But what happens if you actually want to go the other way: you want to marry some music to some video and work on both? That's really what HarrySound is all about, allowing all the facilities you'll expect to see in a conventional edit suite with audio. In other words, not full audio sweetening, but the slipping of tracks, the combining of tracks, the editing of tracks—that sort of thing—all now possible off the tablet. Now your next question, I'm sure, will be, "Yes, but how do you find a creative video person who also knows everything about sound?" One of the advantages of HarrySound is you don't actually have to. The video person can get it to the point that he is doing what they want, but then a necessary professional audio person can be sitting at another panel in a different area and control HarrySound to get all the balances just right, and look after the pure audio aspects.

VIDEOGRAPHY: *When you sit the audio professional down across the room, are you sitting him in front of a Harry monitor and tablet?*

TAYLOR: At a monitor and tablet.

VIDEOGRAPHY: *The philosophy of giving an artist the stylus and letting him work in video is understandable. But what is not as clear is the philosophy of giving an audio mixer the stylus and letting him move icons.*

TAYLOR: I agree with you. And funny enough, actually, in the early discussions we had with Solid State Logic—our sister company that is very much tied up in the whole exercise—some of the pure sound people there said, "You can't edit sound like that!" Those self-same people, when they sat down at HarrySound, said, "Good lord, this really works. You really *can* do it like this!"

It was something that, in our mind's eye, we thought, well, there's a sufficiently good chance, we should try it. And then when we tried it we found that, in fact, audio people actually love it. Not for sweetening—I don't think you'd ever want to start to get involved in sweetening-type things with it—but for relatively straightforward sound editing, it's beautiful.

VIDEOGRAPHY: *While we're talking about new product introductions, what about the Graphic Paintbox? Why is a company that's had its origins in video now getting into the print realm?*

TAYLOR: We were actually forced into it. It would be lovely to sit here and say we had a wonderful master plan, with all these stepping stones across the rapids. But in reality, you sort of bump into ideas as you go along; you build up ideas as people talk to you. One of the things we kept being asked for was from people working at the video board saying they wanted hard-copy output. We also started to notice that we were selling a lot of video Paintboxes in areas that had nothing whatsoever to do with broadcast television. So we finally sat down to build a machine for the print world.

"I think that we are often in the business of creating markets."

VIDEOGRAPHY: *A bit of departure from the line of questioning: We hear, as you list the products and the history of the company, two things, occasionally together and occasion-*

ally separately, pulling the product along. One is the development of a technology, which you've placed out into the marketplace, and then the marketplace is reshaped. The second, which you were just talking about, is the development of a marketplace, in which you develop the technology to support that market. Is that a good analysis of Quantel developments, or it there a philosophy that we're missing?

TAYLOR: I think that we are often in the business of creating markets. Not in the arrogant sense of saying, "This is what you will do, Mr. Customer," but more in putting out ideas, trying out ideas, talking to customers. Ideas begin to appear in conversation. Yes, we are in the business of creating markets: the Paintbox created an entirely new market; Harry created an entirely new market; the Graphic Paintbox, a different market again; and Mirage, really, was a new market. At a time when people were thinking 3D computer graphics, here suddenly comes this machine that allows you to do 3D manipulation of real moving images. The whole thing is to use technological development to help create a market.

VIDEOGRAPHY: *How does high definition—as a product category and as a politically competitive ongoing discussion—fall into your product plans?*

TAYLOR: You probably know that the development of the Graphic Paintbox was effectively the development of a high-definition Paintbox. In order to work, the Graphic Paintbox has an output and input that works in high definition. I think we are one of the larger shippers of high-definition equipment in the world, at the moment, because of this. Yes, we're interested in developing that, and there will be other products that we will release in high definition. I think it's immensely sad that Europe, the USA, and Japan have not been able to reach agreements on a worldwide standard. I can understand different transmission requirements, but a different origination requirement seems to perpetuate the old mistakes.

VIDEOGRAPHY: *The Graphic Paintbox seems to align itself with the 1,125-line/60Hz Japanese standard. Are you going to follow anybody's high-definition product line?*

TAYLOR: Yes. The Graphic Paintbox works at 1125/60, because that was a standard that was there. It worked, you could actually buy devices like monitors and cameras for it. Obviously if Europe goes 1250/50, then we will have to follow suit with a 1250/50 Paintbox. Again, I would think that would be very sad. Because that's a dilution of engineering effort, to just produce the same machine in different standards.

VIDEOGRAPHY: *Speaking of those three realms in the video equipment business—Europe, Japan, and the U.S.—recent alliances between Philips, Bosch, and Thomson are taken by many to signal an effort by Europe to compete with Japan. As a British company, how does Quantel's success contribute to Europe's efforts, in terms of technology, leadership, or even balance of payments?*

TAYLOR: I think we are a very unusual company—being based in the U.K.—innovating products that are sold in Europe, America, and Japan. I think I'm right in saying that Quantel's exports to Japan represent a reasonable proportion

of the U.K.'s electronic exports to Japan. It's an enormously successful market for us. I think that we wish Bosch, Thomson, and Philips good luck in what they're doing. As a company, we work with them from time to time, but I think one of the successes of Quantel is that it has remained relatively small. That gives us a degree of flexibility, and it means we can move very fast when we want to.

VIDEOGRAPHY: *What will be the key to competing with Japan in the future?*

TAYLOR: Quantel is not in the business of making thousands of anything. That is a very good protection. Japan is wonderful at making thousands and millions of things. Quantel would much prefer to make hundreds of things, and then be able to bend them and move them. Going back to what I was saying about evolving products: This business of continually evolving products so the customer is kept up to date requires a lot of effort. It also requires a very flexible manufacturing organization, which tends to be different than what is seen in Japan. Also, the concept of software for creative people is something that the U.S. and the U.K. are very skilled at. Frankly, I think Japan finds that very difficult. That's one of the reasons I'm very happy we are in the business of machines that have a large software content. That software is involved in human interface. Again, I think that's an area where the U.S. and the U.K. can be very strong.

VIDEOGRAPHY: *From what we read in your bio and have heard in the development of your company, Richard Taylor is rather unique in the position he holds. You are the managing director of a major entity in this business, but your background is technology and engineering. We imagine the financial responsibility is on your shoulders these days. How did you make the transition?*

TAYLOR: It's one of those questions you don't actually know the answer to. As the company grew, as what we wanted to do progressed, all of us involved in it learned the skills as we went along. It's most definitely not just me. There is a whole range of people involved in this. I have the privilege of being the spokesman, but really the company is very much a tightly knit group of people where each one knows what the other is thinking and going to say almost before it is said.

VIDEOGRAPHY: *Along the lines of what Quantel has become in the past 15 years, did you expect to be putting out products like this when you founded the company? Of course not. Can you turn that around and extrapolate your expectations of what Quantel will be 15 years from now?*

TAYLOR: Without being repetitive, we're sure that the future lies in giving more and more freedom and facilities to creative people in this industry, in the graphic-arts industry, and elsewhere. We feel that we have hardly scratched the surface of what is still possible in that area.

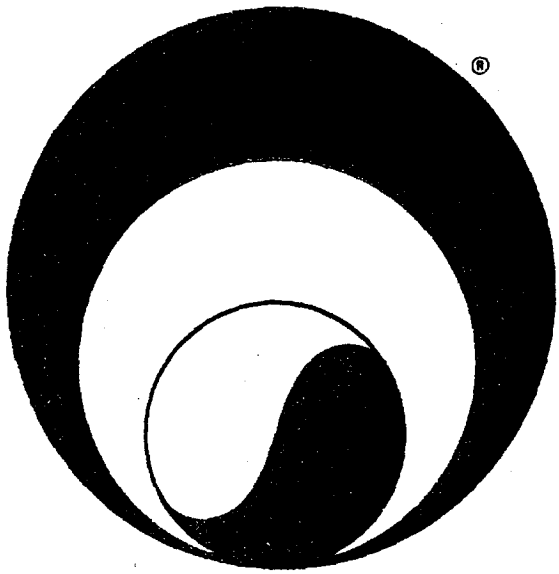
VIDEOGRAPHY: *Earlier you alluded to some soon-to-be-announced products or upgrades. Would you like to take advantage of this opportunity to formally announce them to the public?*

TAYLOR: Quantel is notorious for its reticence to talk about what's coming next, so I will respectfully decline. □

EXHIBIT 16

THE COMPUTER GLOSSARY

IT'S NOT JUST A GLOSSARY!™



FOR EVERYONE by Alan Freedman

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data

UNITS OF INFORMATION WHICH CAN BE PRECISELY DEFINED; Technically, DATA are raw facts and figures which are PROCESSED into INFORMATION. For example: hours worked and hourly rate are DATA; this week's gross pay is INFORMATION. Since we store both DATA and INFORMATION in our FILES and DATA BASES, the terms DATA and INFORMATION are often used synonymously. The traditional view of DATA vs INFORMATION (raw fact vs derived) is an important distinction, however, when a DATA BASE is designed.

As we integrate DATA with TEXT, GRAPHICS and voice (OFFICE AUTOMATION), the use of the term DATA has become even more specific. It implies DATA structures which have a precise definition. DATA are defined by DATA ELEMENTS, which define a unit of DATA according to name, size, type and range of values. Name, address, city, state, zip code and customer number are examples of DATA ELEMENTS. TEXT, GRAPHICS and voice FILES, are STREAM ORIENTED and are structured differently than DATA.

data administration

DATA MANAGEMENT; DATA ADMINISTRATION is the management of an organization's DATA/INFORMATION as an organizational resource. The flow of DATA/INFORMATION within an organization can be complex. The same DATA is viewed differently as it moves from department to department. For example: A customer places an order. That order becomes: a sales commission and quota fulfillment for sales, a demographic statistic for marketing, an order to keep track of in the order processing department, an effect on cash flow projection for financial officers, picking schedules for the warehouse, and production scheduling for manufacturing. USERS have their own view of this DATA and have different requirements for interrogating it and UPDATING it. Operations people need detail, management needs summaries. Before long-lasting DATA BASE designs can be achieved, the DATA and the DATA relationships must be carefully analyzed, classified and maintained. See DATA ADMINISTRATOR.

data administrator

MANAGER OF DATA; DATA ADMINISTRATORS analyze the flow of DATA and INFORMATION in an organization. They analyze USER requirements for DATA and INFORMATION across departmental lines and develop individual USER views of this DATA. DATA ADMINISTRATORS classify groups of related DATA by developing DATA MODELS. The DATA MODELS describe the DATA and their relationships with other DATA and with USERS. DATA MODELS specify common DATA that cross departmental boundaries within an organization. DATA/INFORMATION must be viewed organizationwide in order to develop the proper framework for DATA BASE design. A DATA DICTIONARY is developed which documents the analysis by the DATA ADMINISTRATOR. The DATA MODELS and DATA DICTIONARY, combined with TRANSACTION volume (analyzed by SYSTEMS ANALYSTS) are the raw materials for DATA BASE design.

EXHIBIT 17

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DING ETYMOLOGIES, FULL PRONUNCIATIONS, SYNONYMS, AND AN ENCYCLOPEDIC SUPPLEMENT OF
RAPHICAL AND BIOGRAPHICAL DATA, SCRIPTURE PROPER NAMES, FOREIGN WORDS AND PHRASES,
TICAL BUSINESS MATHEMATICS, ABBREVIATIONS, TABLES OF WEIGHTS AND MEASURES, SIGNS AND
SYMBOLS, AND FORMS OF ADDRESS

ILLUSTRATED THROUGHOUT

Dorset & Baber

WEBSTER'S NEW TWENTIETH CENTURY DICTIONARY

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species; especially, *Dasyurus maculatus*, a small, spotted marsupial.

das·y·ū′rine, *a.* pertaining to the dasyures.

dā′tà, *n.pl.* [*construed as sing.*] [see *datum.*] things known or assumed; facts or figures from which conclusions can be inferred; information.

dā′tà bāse, dā′tà bañk, a large collection of data in a computer, organized so that it can be expanded, updated, and retrieved rapidly for various uses: also written *database, databank.*

dāt′à·ble, *a.* capable of being dated.

dā·tà·mā′tion, *n.* [*data,* and *automation.*] electronic data processing.

dā′tà proc′ess·ing, the recording and handling of information by means of mechanical or electronic equipment.

dā′tà·ry, *n.*; *pl.* **dā′tà·ries,** [ML. *dataria,* from L. *datarius,* for giving away, from *datus,* pp. of *dare,* to give.] in the Roman Catholic Church, a curial official in charge of examining candidates for papal benefices and handling the claims of those with rights to pensions.

dāte, *n.* [ME. *date*; OFr. *date,* the fruit of the date palm; L. *dactylus*; Gr. *daktylos,* a date, lit., a finger, so named from its shape.]
1. the sweet, fleshy fruit of the date palm, *Phœnix dactylifera.*
2. the date palm.

dāte, *n.* [ME. *date*; OFr. *date,* date; L. *data,* neut. pl. of *datus,* pp. of *dare,* to give; the first word in Roman letters or documents, giving the place and time of writing, as *data Romæ,* lit., given at Rome.]
1. a statement on a writing, coin, etc. of when it was made.
2. the time at which a thing happens.
3. the time that anything lasts or goes on.
4. a season or period of time. [Rare.]
5. the day of the month.
6. an appointment for a set time; specifically, a social appointment with a person of the opposite sex.
7. a person of the opposite sex with whom one has such an appointment.
out of date; old-fashioned; no longer in use.
to date; until now; as yet.
up to date; modern; now fashionable.

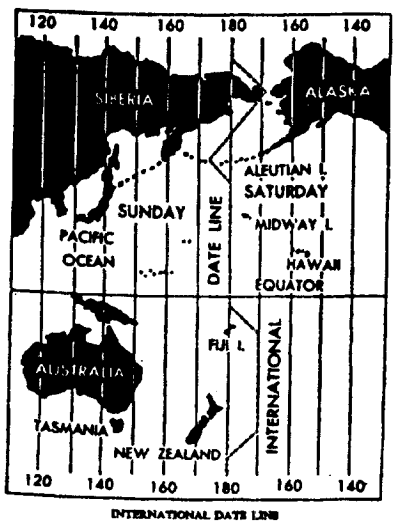
dāte, *v.t.*; dated, *pt., pp.*; dating, *ppr.* 1. to mark (a letter, etc.) with a date.
2. to find out, determine, set, or give the date of.
3. to give a date to.
4. to reckon by dates.
5. to have a social appointment with.

dāte, *v.i.* 1. to be dated (usually with *from*).
2. to belong to, or have origin in, a definite period in the past (usually with *from*).
3. to be old-fashioned.
4. to have social appointments with persons of the opposite sex. [Colloq.]

dāt′ed, *a.* [pp. of *date.*]
1. marked with or showing a date.
2. out of date; old-fashioned.

dāte′less, *a.* 1. without a date.
2. without limit or end.
3. too old for its date to be fixed.
4. still good or interesting though old.

dāte line, 1. a line on which the date of writing or issue is given, as in a letter, a newspaper, etc.



INTERNATIONAL DATE LINE

2. an imaginary line drawn north and south through the Pacific Ocean, largely along the 180th meridian: it is the line at which, by international agreement, each calendar day begins at midnight, so that when it is Sunday just west of the line, it is Saturday just east of it.

dāte pälm, a palm tree that bears dates: some date palms have a tall, slender trunk with foliage at the top, others have a bushy appearance.

dāte plum, the edible fruit of various species of the genus *Diospyros*; also, any of the trees themselves.

dāt′ēr, *n.* one who or that which dates.

Dà·tis′çà, *n.* [L.] a genus of tall exogenous herbs of the family *Datiscaceæ.*

dà·tis′cin, *n.* [from *Datisca.*] in chemistry, a crystalline compound extracted from the leaves and roots of *Datisca cannabina.* It has been used as a yellow dye.

dà·tī′ēl, *n.* in logic, one of the valid moods.

dā·tī′văl, *a.* in the dative case.

dā′tive, *a.* [L. *dativus,* relating to giving; in LL. *casus dativus,* or *dativus* alone, the dative case, from *datus,* pp. of *dare,* to give.]
1. in grammar, denoting or belonging to that case of a noun, pronoun, or adjective which expresses the indirect object of a verb and, in many languages, approach toward something.
2. in law, (a) capable of being given or disposed of at pleasure; being in one's gift; (b) removable, in distinction from *perpetual*: said of an officer; (c) given or appointed by a magistrate or court of justice, in distinction from what is given by law or by a testator; as, in Scottish law, an executor *dative,* whose office is equivalent to that of an administrator.

dā′tive, *n.* 1. the dative case: in English, the dative notion is expressed by *to, for,* or word order (e.g., I gave the book *to Jack,* I did the task *for Jack,* I gave *Jack* the book).
2. a word or phrase in the dative case.

dā′tive·ly, *adv.* as a dative; in the dative case.

dā′tō, *n.*; *pl.* **dā′tōs,** [from Malay *datóq.*]
1. the chief of a Moslem Moro tribe in the Philippine Islands.
2. the chief of a barrio in Malay countries.

dat′ō·līte, dath′ō·līte, *n.* [Gr. *dateisthai* to divide, and *lithos,* stone.] a borosilicate of calcium, occurring usually in glassy crystals.

dat′tŏck, *n.* [W. African name.] *Detarium senegalense,* a tropical African tree of the pea family, having hard wood that resembles mahogany in color.

dā′tum, *n.*; *pl.* **dā′tà,** [L. *datum,* a gift, present, from neut. of *datus,* pp. of *dare,* to give.]
1. [*usually in pl.*] something given, granted, or admitted; a premise upon which something can be argued or inferred; as, the problem could not be solved, owing to insufficient *data.*
2. a real or assumed thing, used as a basis for calculations; as, *datum* point, line, etc.
3. [*pl.*] in mathematics, certain relations or quantities, given or known, from which unknown quantities are determined.

dā′tum līne, the horizontal or base line of a section, from which the heights and depths are reckoned or measured.

dā′tum plāne, an assumed plane of reference forming a basis for measuring heights and depths: sea level is often so used.

Dà·tū′rà, *n.* [L., from Hind. *dhatūrā,* a plant.]
1. a genus of poisonous plants of several species, belonging to the potato family, and having large, funnel-shaped, bad-smelling flowers. *Datura stramonium,* the thorn apple, is a common species.
2. [d–] any plant of this genus.
3. [d–] the flower of the datura.

dà·tū′rine, *n.* a poisonous alkaloid found in the thorn apple: called also *atropine.*

dąub, *v.t.* and *v.i.*; daubed, *pt., pp.*; daubing, *ppr.* [ME. *dauben,* to daub; OFr. *dauber,* to whiten, whitewash; L. *dealbare,* to whiten, whitewash; *de-,* intens., and *albus,* white.]
1. to smear with soft, adhesive matter, such as plaster, grease, etc.; to cover with mud, slime, or other soft substance; to smear.
2. to paint badly and coarsely.
If a picture is *daubed* with many bright colors, the vulgar admire it. —Watts.
3. to cover with something gross or specious; to disguise with an artificial covering.
So smooth he *daubed* his vice with show of virtue. —Shak.
4. to lay or put on without taste; to deck awkwardly or ostentatiously. [Rare.]
Let him be *daubed* with lace. —Dryden.

dąub, *n.* 1. anything daubed on, as plaster grease, etc.
2. a daubing stroke or splash.
3. a poorly painted picture.
4. a kind of mortar; plaster made of mud.

dąub′ẽr, *n.* 1. one who or that which daubs; especially, an unskillful painter.
2. a flatterer.
3. a thing to daub with.
4. a mud wasp: so named from the manner in which it daubs mud in building its nest.

dąub′ẽr·y, dąub′ry, *n.* a daubing; painting or work done in an inartistic or unskillful manner.

dąub′ing, *n.* 1. the act of one who daubs.
2. a material used in daubing.

dąu·bree′līte, *n.* [from G. A. *Daubrée,* a Fr. mineralogist, and Gr. *lithos,* stone.] a metallic sulfide of chromium, a rare mineral of a black color occurring in certain meteoric irons.

dąu·brē′īte, *n.* [named from G. A. *Daubrée,* a Fr. mineralogist.] bismuth oxychloride of a yellowish color.

dąub′y, *a.* of the nature of a daub; viscous; adhesive.

Dąu′çus, *n.* [L., from *daucus, daucum*; Gr. *daukos, daukon,* a carrotlike plant growing in Crete.] a genus of umbelliferous plants of several species, with spinous fruit of a somewhat compressed ovate or oblong form. *Daucus carota* is the cultivated carrot.

dąud, *n.* same as *dad* (a blow).

dąugh′tẽr (dą′), *n.* [ME. *doughter*; AS. *dohtor,* daughter, prob. from Sans. *duhitár,* daughter, lit., milker, from *duh,* milk.]
1. a girl or woman in her relationship to either or both parents.
2. a female descendant.
3. a female thought of as if in the relation of child to parent; as, a *daughter* of France.
4. anything thought of as like a daughter in relation to its source or origin; as, the colonies are the *daughters* of the mother country.

dąugh′tẽr, *a.* having the natural characteristics of a daughter; also, in biology, related in the first degree or generation, without reference to sex.

dąugh′tẽr cell, in biology, one of the cells formed by the division of another cell.

dąugh′tẽr-in-ląw, *n.*; *pl.* **dąugh′tẽrs-in-ląw,** the wife of one's son.

dąugh′tẽr-li·ness, *n.* the state or quality of being daughterly.

dąugh′tẽr·ly, *a.* 1. of a daughter.
2. like, characteristic of, or becoming a daughter; dutiful; as, *daughterly* affection.

dąugh′tẽr of Eve, any woman or girl.

Dąun, *n.* Dan: a title of respect. [Obs.]

dąun′dẽr, *v.i.* same as *dander.*

dąunt, *v.t.*; daunted, *pt., pp.*; daunting, *ppr.* [ME. *daunten*; OFr. *danter, donter,* to daunt, subdue, tame, from L. *domitare,* to tame, break in, freq. of *domare,* to tame, subdue.]
1. to make afraid; to intimidate.
2. to dishearten.
3. to conquer; to subdue. [Obs.]
Syn.—intimidate, dismay, frighten, dishearten, cow, appal, terrify.

dąunt′ẽr, *n.* one who daunts.

dąunt′less, *a.* that cannot be daunted; bold; fearless; not timid; not discouraged; as, a *dauntless* spirit.

dąunt′less·ly, *adv.* in a dauntless manner.

dąunt′less·ness, *n.* the state or quality of being dauntless.

dąu′phin, *n.* [Fr., from OFr. *dauphin, daulphin,* the dauphin, from L. *delphinus,* a dolphin: a name assumed about the middle of the ninth century by the lord of the French province of Dauphiny, which was bequeathed by Humbert III to the king of France, in 1349, on condition that the heir of the throne should bear the title of *Dauphin* of Viennois.] the eldest son of the king of France: a title used from 1349 to 1830.

dąu′phin·ess, dąu′phine, *n.* the wife of a dauphin.

dąut, *v.t.* [Scot. Gael.] to fondle; to pet; to caress: also spelled *dawt.* [Scot.]

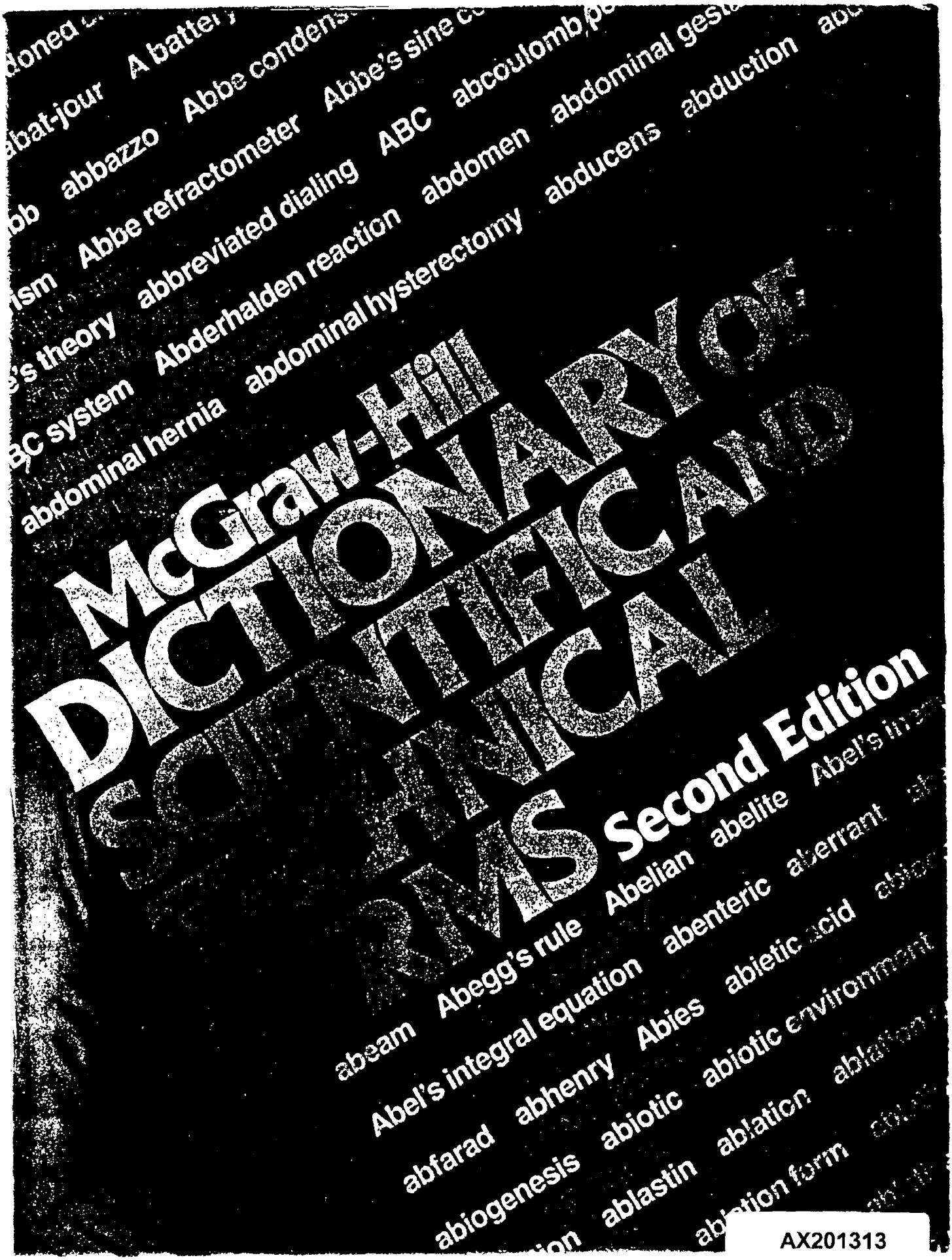
dąuw (dą), *n.* [S. Afr. D. form of native name.] *Equus burchelli,* a South African zebra: it somewhat resembles the quagga.

dā′vẽn, *v.i.*; davened, *pt., pp.*; davening, *ppr.* [Yid. *davnen,* to pray.] in Judaism, to recite the prayers of the daily or of a holiday liturgy.

dav′ẽn·port, *n.* [from the name of the original manufacturer (19th c.).]
1. a small desk with a hinged lid that opens out for writing.
2. a large couch or sofa, sometimes convertible into a bed.

Dā′vid, *n.* in the Bible, the second king of Israel and Judah, succeeding Saul and followed

EXHIBIT 18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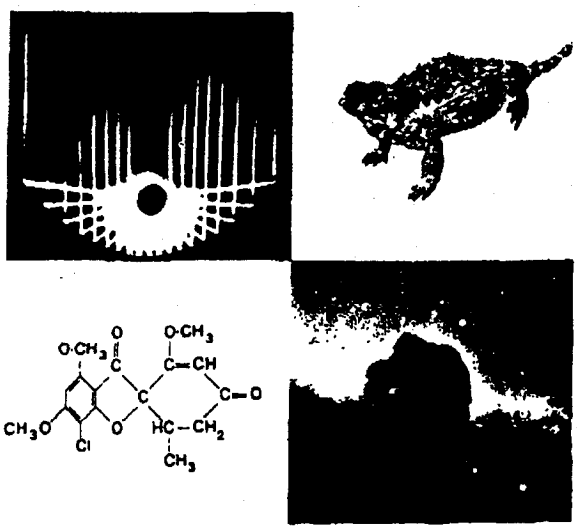

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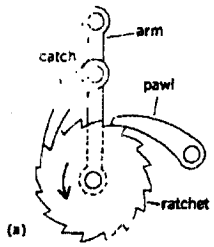
RASPBERRY

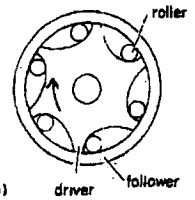
A red raspberry branch, Loudon variety. *(USDA)*

RAT

The brown Norway or common rat *(Rattus norvegicus)*. One of the worst pests in the United States, it destroys billions of dollars worth of farm products annually.

RATCHET





Ratchet mechanisms. *(a)* Toothed ratchet is driven in direction of arrow by catch when arm moves to left; pawl holds ratchet during return stroke of catch. *(b)* In roller ratchet, rollers become wedged between driver and follower when driver turns faster than follower in direction of arrow.

used to make lubricants and rubber substitutes, as an illuminant, and in steel heat treatment. Also known as colza oil; rape-seed oil.

rape-seed oil *See* rape oil.

raphania [MED] A disease thought to be due to chronic ingestion of the poison in seeds of the wild radish.

raphe [ANAT] A broad seamlike junction between two lateral halves of an organ or other body part. [BOT] 1. The part of the funiculus attached along its full length to the integument of an anatropous ovule, between the chalaza and the attachment to the placenta. 2. The longitudinal median line or slit on a diatom valve.

Raphidae [VERT ZOO] A family of birds in the order Columbiformes that included the dodo (*Raphus calculatus*); completely extirpated during the 17th and early 18th centuries.

raphide [BOT] One of the long, needle-shaped crystals, usually consisting of calcium oxalate, occurring as a metabolic by-product in certain plant cells.

rapid [HYD] A portion of a stream in swift, disturbed motion, but without cascade or waterfall; usually used in the plural.

rapid access loop [ADP] A small section of storage, particularly in drum, tape, or disk storage units, which has much faster access than the remainder of the storage.

rapid-curing asphalt [MATER] A liquid asphalt composed of asphalt cement and a gasoline- or naphtha-type diluent. Abbreviated RC asphalt.

rapid-eye-movement sleep [PSYCH] That part of the sleep cycle during which the eyes move rapidly, accompanied by a loss of muscle tone and a low-amplitude encephalogram recording; most dreaming occurs during this stage of sleep. Abbreviated REM sleep.

rapid fire [ORD] Rate of firing small arms or automatic weapons, faster than slow fire, but slower than quick fire.

rapid memory *See* rapid storage.

rapid sand filter [CIV ENG] A system for purifying water, which is forced through layers of sand and gravel under pressure.

rapid selector [ADP] A device which scans codes recorded on microfilm; microimages of the documents associated with the codes may also be recorded on the film.

rapid sequence camera [OPTICS] A conventional camera in most respects except that it is designed to permit a number of photographs to be obtained in rapid succession with one winding of the shutter.

rapid storage [ADP] In computers, storage with a very short access time; rapid access is generally gained by limiting storage capacity. Also known as high-speed storage; rapid memory.

rapid traverse [MECH ENG] A machine tool mechanism which rapidly repositions the workpiece while no cutting takes place.

raptorial [ZOO] 1. Living on prey. 2. Adapted for snatching or seizing prey, as birds of prey.

rapture of the deep *See* nitrogen narcosis.

rare-earth alloy [MET] An alloy containing rare-earth materials.

rare-earth chelate laser *See* chelate laser.

rare-earth element [CHEM] The name given to any of the group of chemical elements with atomic numbers 58 to 71; the name is a misnomer since they are neither rare nor earths; examples are cerium, erbium, and gadolinium.

rare-earth garnet [MATER] A synthetic garnet having the general structure of grossularite, but with calcium replaced by a rare-earth metal, and aluminum and silicon replaced by iron; used for electronic applications.

rare-earth magnet [ELECTROMAG] Any of several types of magnets made with rare-earth elements, such as rare-earth-cobalt magnets, which have coercive forces up to ten times that of ordinary magnets; used for computers and signaling devices.

rare-earth mineral [MINERAL] A mineral having a high concentration of rare-earth elements; examples are monazite, xenotime, and bastnaesite.

rare-earth salts [INORG CHEM] Salts derived from monazite, and with rare earths in similar proportions as in monazite; contains La, Ce, Pr, Nd, Sm, Gd, and Y as acetates, carbonates, chlorides, fluorides, nitrates, sulfates, and so on.

rarefaction [ACOUS] The instantaneous, local reduction in density of a gas resulting from passage of a sound wave, or the region in which the density is reduced at some instant.

rarefaction wave [FL MECH] A pressure wave or rush of air or water induced by rarefaction; it travels in the opposite direction to that of a shock wave directly following an explosion. Also known as suction wave.

rarefied gas [FL MECH] A gas whose pressure is much less than atmospheric pressure.

rare gas *See* noble gas.

rare metal [MET] Any metal that is difficult to extract from ore and is rare and expensive commercially; includes masurium, alabamine, and virginium.

RAREP *See* radar report.

Rarita-Schwinger equation [QUANT MECH] A partial differential equation, similar in form to the Dirac equation, relating the spatial and time dependence of a 16-component wave function describing a free relativistic particle with intrinsic spin ⅜, and its antiparticle.

Raschig process [CHEM ENG] A method for production of phenol that begins with a first-stage chlorination of benzene, using an air–hydrochloric acid mixture.

Raschig ring [CHEM ENG] A type of packing in the shape of a short pipe; used in columns for absorption operations, and to a limited extent for distillation operations.

rash [MED] A lay term for nearly any skin eruption, but more commonly for acute inflammatory dermatoses.

RA size [ENG] One of a series of sizes to which untrimmed paper is manufactured; for reels of paper, the standard sizes in millimeters are 430, 610, 860, and 1220; for sheets of paper, the sizes are RA0, 860 × 1220; RA1, 610 × 860; RA2, 430 × 610; RA sizes correspond to A sizes when trimmed.

rasorial [ZOO] Adapted for scratching for food; applied to birds.

rasorite *See* karnite.

rasp [DES ENG] A metallic tool with a rough surface of small points used for shaping and finishing metal, plaster, stone, and wood; designed in a number of useful curved shapes.

raspberry [BOT] Any of several species of upright shrubs of the genus *Rubus*, with perennial roots and prickly biennial stems, in the order Rosales; the edible black or red juicy berries are aggregate fruits, and when ripe they are easily separated from the fleshy receptacle.

raspite [MINERAL] $PbWO_4$ A yellow or brownish-yellow mineral composed of lead tungstate, occurring as monoclinic crystals.

raster [ELECTR] A predetermined pattern of scanning lines that provides substantially uniform coverage of an area; in television the raster is seen as closely spaced parallel lines, most evident when there is no picture.

raster scanning [ELECTR] Radar scan very similar to electron-beam scanning in an ordinary television set; horizontal sector scan that changes in elevation.

Rast method [ANALY CHEM] The melting-point depression method often used for the determination of the molecular weight of organic compounds.

rat [VERT ZOO] The name applied to over 650 species of mammals in several families of the order Rodentia; they differ from mice in being larger and in having teeth modified for gnawing.

RAT *See* rocket-assisted torpedo.

ratarta larva [INV ZOO] The second, hourglass-shaped, free-swimming larva of the siphonophore *Velella*.

rat-bite fever [MED] Either of two diseases transmitted by the bite of a rat: spirillary rat-bite fever and streptobacillary fever.

ratchet [DES ENG] A wheel, usually toothed, operating with a catch or a pawl so as to rotate in only a single direction.

ratchet coupling [MECH ENG] A coupling between two shafts that uses a ratchet to allow the driven shaft to be turned in one direction only, and also to permit the driven shaft to overrun the driving shaft.

ratchet jack [DES ENG] A jack operated by a ratchet mechanism.

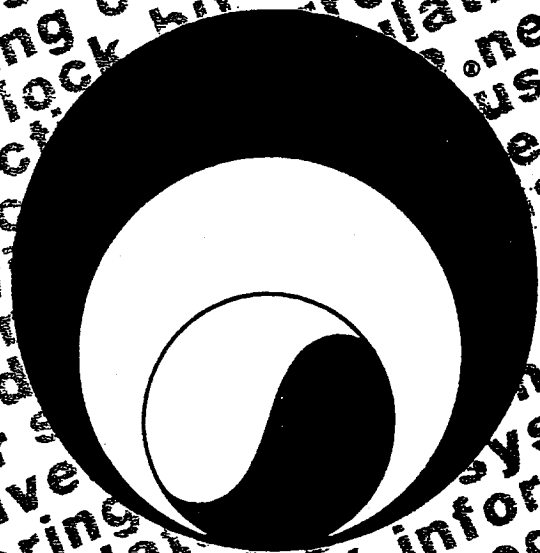
ratchet tool [DES ENG] A tool in which torque or force is applied in one direction only by means of a ratchet.

rate [SCI TECH] The amount of change of some quantity

EXHIBIT 19

THE COMPUTER GLOSSARY

IT'S NOT JUST A GLOSSARY!



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FOR EVERYONE

By ALAN FREEDMAN

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raster graphics

COMPUTER GRAPHICS CODING TECHNIQUE; The RASTER GRAPHICS technique represents a picture as thousands of dots which make up a viewing area. RASTER GRAPHICS is similar to television, except that there is no national standard as there is in TV. See GRAPHICS (Raster Graphics).

RCS

REMOTE COMPUTER SERVICE; RCS is synonymous with remote TIME-SHARING services.

read

INPUT TO THE COMPUTER; A READ generally refers to the transfer of a copy of INFORMATION from a DISK, TAPE, or BUBBLE MEMORY device into the COMPUTER'S MEMORY. READING does not destroy the content of the device being READ. It's just like reading a book or playing a tape on a home tape recorder. The content still remains in its original place.

Internal MEMORY (RAM and ROM) is READ as well when INSTRUCTIONS and INFORMATION are being copied out of it, either to the PROCESSOR or to another place in the RAM.

read error

THE CONTENT OF A STORAGE DEVICE CANNOT BE ELECTRONICALLY IDENTIFIED; If the magnetic recording surface of a DISK or TAPE is contaminated with dust or dirt, or is physically damaged, the BITS may become unreadable. If there is a malfunction of one of the ELECTRONIC components in a storage CHIP, the contents may be unreadable.

read only

STORAGE DEVICES WITH PERMANENT CONTENT; ROMs, PROMs and VIDEODISCS are examples of READ ONLY devices.

reader

PERIPHERAL DEVICE; A READER is usually an INPUT device, such as a PUNCHED CARD READER, MAGNETIC CARD READER or OCR READER. However, a MICROFICHE or MICROFILM READER is an OUTPUT device.

AX203312

EXHIBIT 20

GUIDES
- Components
- Storage
- Multimedia
- Input/Output
- Communications
GLOSSARY
TUTORIALS
USER FORUMS

GLOSSARY - BY CATEGORY

Its integrated Glossary is an important feature of the PC Technology Guide, designed both to assist in the use of the guide itself and also to provide a general resource to help visitors understand the vast amount of "jargon" which abounds in the PC world.

It does this by exploiting the power of the Web's hyper-linking feature to cross-reference the guide and the glossary in both directions. All links from the guide are to the glossary and vice versa. The former can be used by clicking links on guide pages to provide a brief formal definition of the associated terminology or by issuing direct "Word Lookup" enquiries. The latter reference points in the guide where particular terms are covered in more detail.

The glossary has been broken down into a number of categories to facilitate its use for site navigation. Generic terminology is grouped in a general category and the other categories are closely aligned to the organisation of the guide itself. In some cases, the choice of category in which to include a term is somewhat arbitrary. For example, terminology that can be applied to the fields of "still" graphics (including 3D) and sound appear in their own categories rather than in the very broad "multimedia" category.

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Category: Displays (80 terms)

The various different monitors and the related jargon clarified

Term	Definition
Active Matrix	An LCD technology used in flat panel computer displays. It produces a

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	brighter and sharper display with a broader viewing angle than passive matrix screens. Active matrix technology uses a thin film transistor at each pixel and is often designated as a "TFT" screen. See also Passive Matrix.
Additive Colour	Colour produced by "adding" colours, usually the combination of red, green and blue.
Ambient Light Sensor	A light sensor at the top of the monitor which gauges ambient light in the work environment and automatically adjusts the brightness of the monitor for optimum viewing. This takes away the frequent and tedious task of manually adjusting brightness on the screen; it is particularly beneficial in environments where light in the office is subject to change throughout the day.
Anode	A positively charged electrode used to attract (negatively charged) electrons in a CRT monitor.
Aperture Grille	The phosphor separation method used in a Trinitron CRT in place of a shadow mask. A series of thin, closely-spaced vertical wires are used to isolate pixels horizontally. The pixels are separated vertically by the nature of the scan lines used to compose the image.
Aspect Ratio	The relationship of width and height. When an image is displayed on different screens, the aspect ratio must be kept the same to avoid "stretching" in either the vertical or horizontal direction. For most current monitors, this ratio is 4:3. For HDTV, the ratio is generally 16:9.
Astigmatism	A lens aberration that causes off-axis light electron beams to focus to an elliptical, rather than circular, spot. The larger the monitor size, the greater the problem.
Autoscan	A microprocessor-based feature of some monitors incorporating automatic synchronisation of their horizontal and vertical frequencies with those of the installed video graphics adapter. An autoscan monitor can thus operate with a wide range of video adapters.
Backlight	An LCD screen that has its own light source from the back of the screen, making the background brighter and characters appear sharper.
Barrel	A type of image distortion where vertical

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Distortion	lines are bowed outwards, towards the edges of the screen.
Bezel	The border around the edge of the screen, covering the extremities of a CRT. Also used to describe the rim around the perimeter of faceplates - often clip-on - of drive bays and even PC cases, used to vary their appearance.
Bifringence	The property of a material which causes incident light waves of different polarisations to be refracted differently by the material.
Blooming	A problem where bright white areas have a slight halo around them.
BNC	A video connection type found on many high-end monitors. It consists of five separate cables for red, green, blue, horizontal and vertical synchronisation signals.
Candela	A unit of measurement of the intensity of light. An ordinary wax candle generates one candela. The maximum brightness for CRTs is about 100 to 120 cd/m2 and for TFTs, up to 250 cd/m2.
Cathode	An electrode that is negatively charged. Electrons are released from the cathode in a CRT monitor.
Colour Temperature	Defines the whiteness of the white on the screen. Variations are measured in degrees Kelvin. Natural colours used in life-like images, such as people or landscapes, look more true to life when displayed at a colour temperature of 6500K. Black text on a white page is better represented by a colour temperature of 9300K.
Composite Video	A video signal format that includes the complete visual waveform, including: chrominance (colour), luminance (brightness), blanking pedestal, field, line, colour sync pulses and field qualising pulses.
Convergence	The term used to describe how accurately the three (red, green, and blue) electron beams converge to illuminate their respective phosphors in a colour monitor. The better the guns converge, the sharper the image. If a monitor shows poor convergence, edges of objects will have a red, blue or green tinge.
CRT	Cathode Ray Tube: the tube of a television or monitor in which rays of

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	electrons are beamed onto a phosphorescent screen to produce images. Often used as a generic term for a computer monitor.
CSTN	Colour Super-Twist Nematic: a passive matrix LCD technology developed by Sharp Electronics Corporation.
D-SUB Connector	A type of monitor socket and cable plug found on all PC monitors. It consists of a single cable that carries all the video information and uses the same pin layout as the socket on a graphics card.
DDC	Display Data Channel: DDC 1/2B and 2AB are standardised techniques by which monitors and graphics cards communicate with each other to help establish the best resolution and refresh rate combination. DDC is only possible through a D-SUB connection.
Deflection Yoke	The arrangement of electromagnets which can alter the direction of the electron beam that passes through it.
Degauss	Magnetic interference caused by a change in the position of a monitor in relation to the earth's magnetic field or the presence of an artificial magnetic field can cause discoloration. To correct this, all colour monitors automatically degauss at power-on and some also have a manual degaussing button. This allows the monitor to compensate for the change in the magnetic field by realigning the electron guns.
DLP	Digital Light Processor: an all-digital display technology that turns image data into light. Enabled by a DMD device, DLP is capable of projecting sharp, clear images of almost any size without losing any of the original image's resolution.
DMD	Digital Micromirror Device: an array of semiconductor-based digital mirrors that precisely reflect a light source for projection display and hard-copy applications. A DMD enables Digital Light Processing and displays images digitally. Rather than displaying digital broadcast signals as analogue signals, a DMD directs the digital signal directly to your screen.
Dot Pitch	A measurement of distance between the centres of two same-colour phosphor dots on the screen. The closer the dots, the smaller the dot pitch, and the sharper the image. See

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	also Stripe Pitch.
Dot Trio	The standard phosphor triad arrangement.
DPMS	Display Power Management Signalling: displays or monitors that comply with this can be managed by Power Management features found in CMOS configuration on Energy Saving PCs.
DSTN	Double-layer SuperTwist Nematic: a passive-matrix LCD technology that uses two display layers to counteract the colour shifting that occurs with conventional supertwist displays. Also referred to as dual-scan LCD.
DVI	Digital Visual Interface: standard for digitally connecting graphics cards with monitors.
Dynamic Focus	The ability of a CRT monitor's electron gun to adjust focus so that it is sharp across the whole screen - not just the centre.
EDP	Enhanced Dot Pitch: Hitachi's tube technology in which the phosphor triads are spaced closer together horizontally than they are vertically.
Electron Beam	The invisible stream of electrons that flow from a CRT monitor's cathode to its screen.
Energy Star	Launched in 1993, this is a program established by the Environmental Protection Agency (EPA) as a partnership with the computer industry to promote the introduction of energy-efficient personal computers which help reduce air pollution caused by power generation. To comply with the Energy Star guidelines, a computer system or monitor must consume less than 30 watts of power in its lowest power state.
FED	Field Emission Display: a display technology which use vacuum tubes (one for each pixel) with conventional RGB phosphors.
Flat Panel Display	A thin display screen that uses any of a number of technologies, such as LCD, plasma and FED. Traditionally used in laptops, flat panel displays are slowly beginning to replace desktop CRTs for specialised applications.
Footlambert	fL: a unit of luminance equal to 3.463 candelas per square metre.
FST	Flat Square Tube: describes the viewing surface of a cathode ray tube

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	that is nearly flat. Flatter screens give the appearance of straighter lines, and they can aid in the reduction of glare, compared to conventional tubes.
Ghosting	A visual effect in which an area of 'on' pixels causes a shadow on 'off' pixels in the same rows and columns. A particular problem with passive matrix LCDs.
HSF	Horizontal Scanning Frequency: indicates the speed, measured in kilohertz, at which a single horizontal line is drawn on the screen. Higher scan rates are needed to provide sharper, crisper images at higher resolutions. Also called scan rate.
HTPS	High Temperature Poly-Silicon: A thin-film transistor (TFT) panel is an active matrix display containing a microscopic thin-film transistor in the corner of each pixel. HTPS panels allow driver ICs to be embedded into their TFTs, thereby allowing greater miniaturisation (higher pixel counts and higher aperture ratios).
Interlaced	Scheme to display a video image by displaying alternate scan lines in two discrete fields.
Invar	Type of metal used in the shadow mask that provides more consistent images over time, by reducing warping of the shadow mask when bright images are displayed.
Jitter	The interference that occurs - causing a shimmering effect that results in lines and characters to losing their focus - when a TFT panel's clock and phase aren't perfectly synchronised.
LCD	Liquid Crystal Display: a display technology that relies on polarising filters and liquid crystal cells rather than phosphors illuminated by electron beams to produce an on-screen image.
LED	Light Emitting Diode: a display technology that uses a semiconductor diode that emits light when charged. LEDs are usually red. It was the first digital watch display, but was superseded by LCD, which uses less power.
LEP	Light-Emitting Polymer: a display technology in which plastics are made to conduct electricity and, under certain conditions, emit light.
Modes	Specific frequencies at which the

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	monitor (and/or computer) can display text or graphical information. Most monitors today support several frequencies. This is called multifrequency or multi-scanning, and it ensures that the monitor will perform with a variety of computers and applications.
MPR2	Provides reduced electrostatic and electromagnetic emissions. MPR 1990, or MPR2, is a standard defined to measure emissions from devices such as monitors.
Multi-Frequency	A monitor's ability to change resolution or refresh rate when signalled by a video adapter. Graphics adapters have the ability to "tell" a monitor to use various display resolutions and refresh rates. If the resolution or refresh rate is within a monitor's scanning range, multi-frequency monitors adjust to the resolutions and refresh rates "ordered" by the video adapter. Also known as multi-scanning. See also Modes.
Multiscan	A monitor that can display many different resolutions. A single-scan monitor can only display a particular resolution.
nit	A unit of luminance equal to one candlepower measured at a distance of 1m over an area of 1 square metre. One nit is equal to 1 candela per square metre or 0.2919 fL (footlamberts).
nT	nano Tesla: a unit of measurement for magnetic flux density. A magnetic field of one Tesla is very strong - the earth's magnetic field is only tens of nano-Teslas.
OLED	Organic Light-Emitting Diode: a display device invented by Eastman Kodak in the early 1980s. OLEDs sandwich carbon-based films between two charged electrodes, one a metallic cathode and one a transparent anode. The organic films consist of a hole-injection layer, a hole-transport layer, an emissive layer and an electron-transport layer. When voltage is applied to the OLED cell, the injected positive and negative charges recombine in the emissive layer and create electro luminescent light.
Overscan	A condition that exists when a created image is larger than the visible portion of the display. Overscan helps relegate

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	the relatively fuzzy perimeter of a CRT image to portions of the screen that are out of sight, and the overscan may disappear over time anyway. On the other hand, monitors with excessive overscan can lose icons and text at the edges of the display.
PanelLink	Developed by Silicon Images Inc. to provide an all digital link between a graphics card and an LCD monitor, PanelLink uses Transition Minimised Differential Signalling (TMDS) signalling technology, allowing a distance of up to 10m between the graphics card and the LCD panel.
Parallelogram Distortion	A type of geometric distortion, where lines are parallel but not perpendicular.
Passive Matrix	A common LCD technology used in laptops. Passive matrix displays (DSTN, CSTN, etc.) are not quite as sharp and do not have as broad a viewing angle as active matrix (TFT) displays, but they have improved dramatically in recent years.
PDP	Plasma Display Panel: a display technology that works on the principle that passing a high voltage through a low-pressure gas creates light.
Phosphor	A luminescent substance, used to coat the inside of the cathode-ray tube display, that is illuminated by the electron gun in the pattern of graphical images as the display is scanned.
Phosphor Triad	One red, one green and one blue phosphor that composes a pixel.
Pincushion Distortion	The opposite of barrel distortion. The vertical lines in a rectangular image curve inwards, with an increase in the distortion towards the edges of the image.
Pixel	An abbreviation for picture element. In a raster grid, the pixel is the smallest unit that can be addressed and given a colour or intensity. The pixel is represented by some number of bits (usually 8, 16 or 24) in the frame buffer, and is illuminated by a collection of phosphor dots in the CRT that are struck by the beams of the electron gun.
Pixel Clock Speed	The frequency or speed at which individual pixels (picture elements) in an image are written to the screen. The higher the pixel clock speed, the less

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	likely there will be flicker.
Raster	A raster is a rectangular grid of picture elements representing graphical data for display. Raster operations (ROPs) can be performed on some portion or all of the raster.
Response Time	It typically takes around 25ms for the liquid crystal inside a modern TFT panel to respond to the applied current, which is usually more than enough to fool the naked eye into seeing fluid movement. Quoted response times include an element of latency, when a pixel remains lit for a short time after the current has been removed.
RGB	Red-Green-Blue: a way of encoding images in computer graphics by describing a colour by the amount of the three basic colours Red, Green and Blue. Three bytes are required for "true colour" (three numbers between 0 and 255), giving a theoretical maximum of 16.7 million colours. Computer monitors are generally driven by an RGB signal. The other technique for output display is composite video, which typically offers less resolution than RGB.
Rotation	Determines how well the image area lines up to the bezel; also called tilt.
Screen Regulation	A distortion where the size of the image varies according to the brightness of the screen content. A white rectangle will appear larger when surrounding a solid white rectangle than when surrounding a plain black area.
Shadow Mask	The perforated metal sheet that rests between the electron gun and a screen's phosphor coating to ensure that the three electron beams only strike the correct phosphor dots. A 'shadow mask display' is a monitor which conforms to the conventional three-electron gun, shadow mask design.
Slotted Mask	A variation on the aperture grill phosphor triad approach which uses the slot-mask design used on many non-Trinitron TV sets.
Streaking	A visual effect which is related to 'white level shift' and 'black level shift', where the difference in intensity between neighbouring white and black areas results in a discoloration. Occurs when a CRT's electron gun does not switch on and off quickly enough.

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Stripe Pitch	This is similar to dot pitch, but applicable tubes which the aperture grille method to separate phosphors. Dot stripe is measured as the distance between the vertical stripes that result. Measures of dot pitch and dot stripe are not directly comparable.
Tesla	Magnetic fields, or more specifically, magnetic flux densities historically have been measured with a unit called the milligauss - 1 milligauss(mg) being equal to 0.001 Gauss(g). Electrical engineers and physicists use the Tesla as a unit of international standard, one Tesla being the equivalent to 10,000 Gauss or 10,000,000 milligauss. Typically the Tesla is used in technical journals and the milligauss unit is used in information for the general public.
TFT	Thin Film Transistor: a type of LCD flat-panel display screen, in which each pixel is controlled by from one to four transistors. TFT technology provides the best resolution of all the current flat-panel techniques. TFT screens are sometimes called active-matrix LCDs.
TN	Twisted Nematic: the first LCD technology. It twists liquid crystal molecules 90 degrees between polarises. TN displays require bright ambient light and are still used for low-cost applications.
Trapezoidal Distortion	A type of geometric distortion where the vertical edges of an image slant inwards towards the top horizontal edge. Also called keystone distortion.
Unbalanced Pin	Describes concave and convex lines on opposite sides of the screen.

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